



BP Biofuels

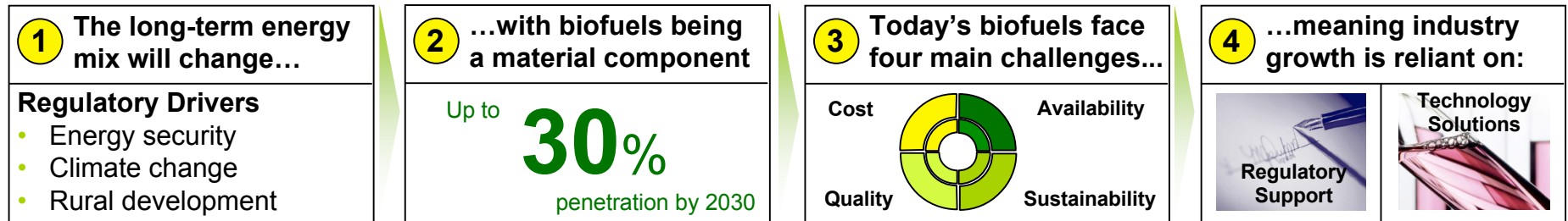
a growing alternative



Ruth Scotti
US Policy Manager

Advanced Biofuels for California's Transportation Sector
Sacramento CA, June 11, 2007

Introduction



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a growing alternative

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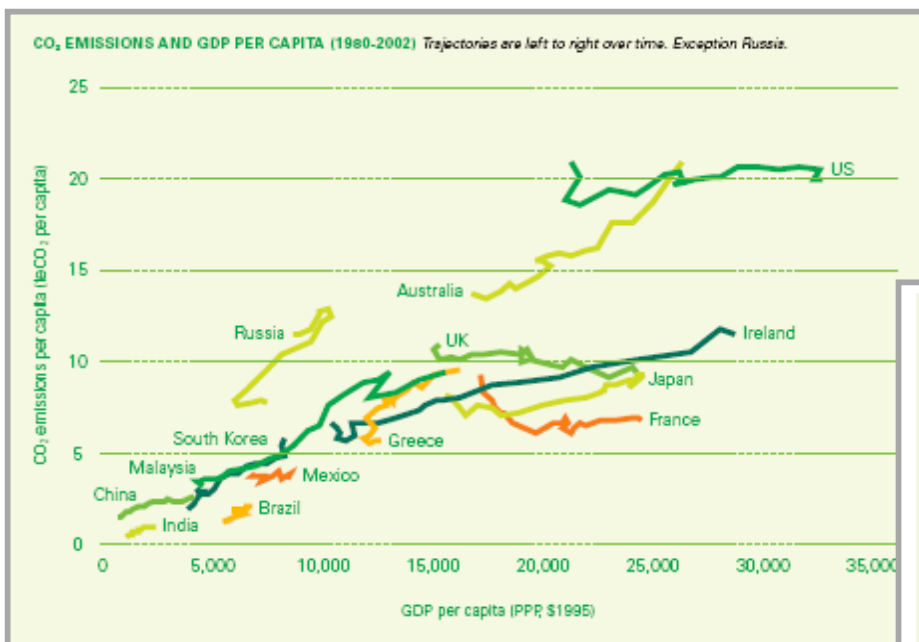


1 The long-term energy mix will change...

Regulatory Drivers

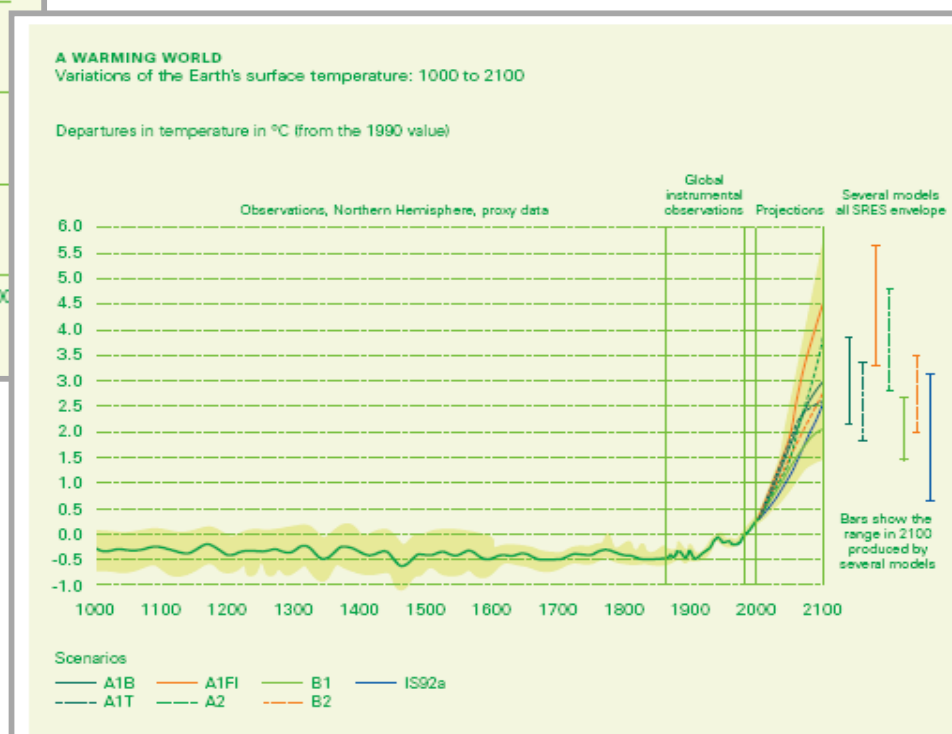
- Energy security
- Climate change
- Rural development

Energy is at the heart of the world economy.
World population growth continues rapidly.
Economic development lifts energy usage.



GHG Emissions Per Capita

Temperature Changes



Source: UN IPCC Climate Change 2001; Synthesis Report. Summary for Policymakers

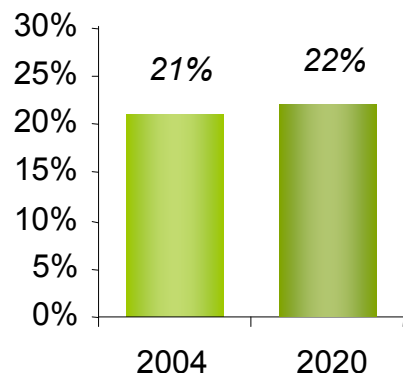
2 ...with biofuels being a material component

Up to **30%**
penetration by 2030

Given an increasing global energy demand, biofuels are the best supply side option for ground transportation

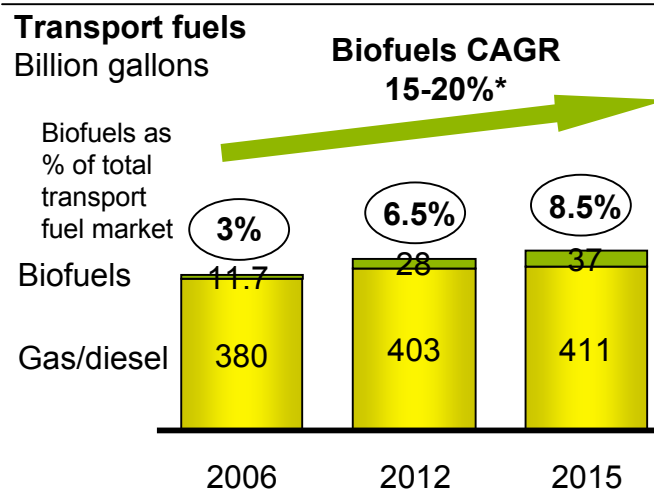


Transport's Contribution to Total CO₂



Source: IEA World Energy Outlook, 2004

Biofuels represent ~40% of the predicted global growth in transport fuels



* Biofuels could reach 30% of the fuel pool by 2030
Source: Tecknon 2006, Team analysis

- Energy dependency and climate change will remain primary motivators for pursuing alternative and renewable transport fuels
- For ground transportation, biofuels are the best supply side option to meet both challenges in a material way by 2030. They also support rural development.



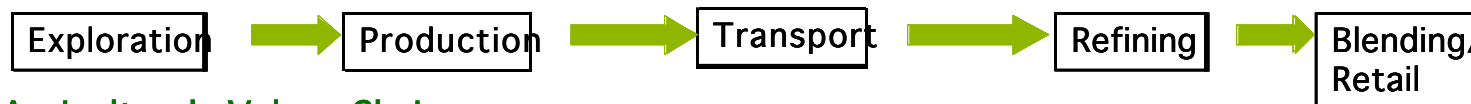
3 Today's biofuels face four main challenges...



From carbohydrates to hydrocarbons

- The biofuels industry is being created through the fusion of the two most important primary industries in the world – agriculture and energy

Petroleum Value Chain:



Agricultural Value Chain:



Biofuels Value Chain:



- But today's biofuels face 4 main challenges...

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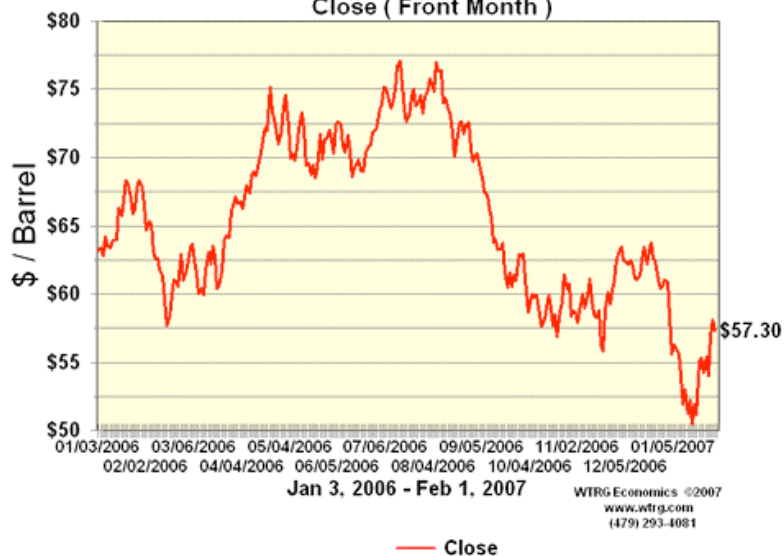
Cost: production economics are volatile, caught between feedstock costs and oil prices



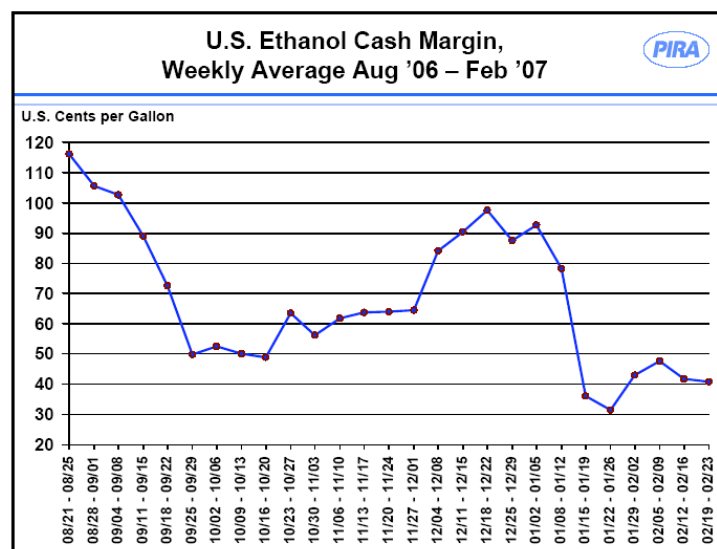
CBOT Corn Futures – July 07 delivery (\$/bushel)



NYMEX Crude Oil Futures
Close (Front Month)



ILLUSTRATIVE EXAMPLE – US ETHANOL



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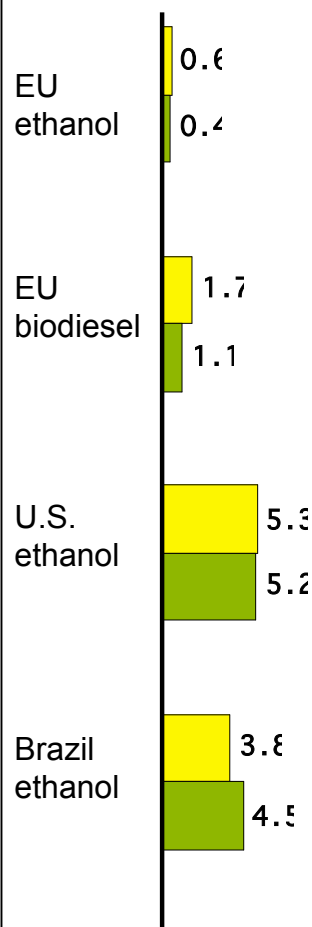
2a

Availability: biofuels currently represent 2-3% of the transport fuel pool. Today, feedstocks limit penetration to around 5-7%



2006 current demand and production capacity (bn galls)

■ Demand ■ Supply Conventional feedstock



2006 to 2011

Europe constraints

- **Distribution** – need ethanol infrastructure for distribution, blending and retail
- **Ethanol** – max feedstock limit reached with 5.75% target.
- **Bio-diesel** – max limit from rapeseed will be 1.1bn galls short of target; B5 will limit further penetration

US constraints

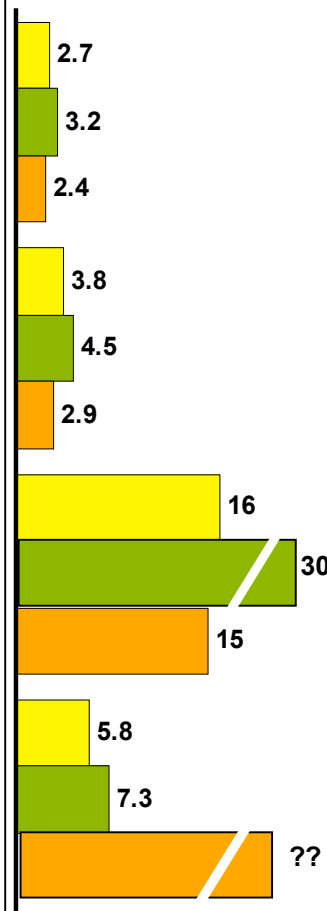
- **Distribution** – rail car production capacity backlog of ~3 years
- **Growth** – limited by construction
- **Economics** – Increasing corn price will erode margin and limit growth to RFS and mandate volumes

Brazil constraints

- **Distribution** – Trucking is primary method, despite long distances and limited capacity resulting in high costs; limited port facilities
- **Risk management** – lack of paper market for hedging will limit exports

2011 predicted demand and maximum conventional feedstock supply (bn galls)

■ Demand ■ Announced Capacity ■ Feedstock Limit



2011 forward

Europe constraints

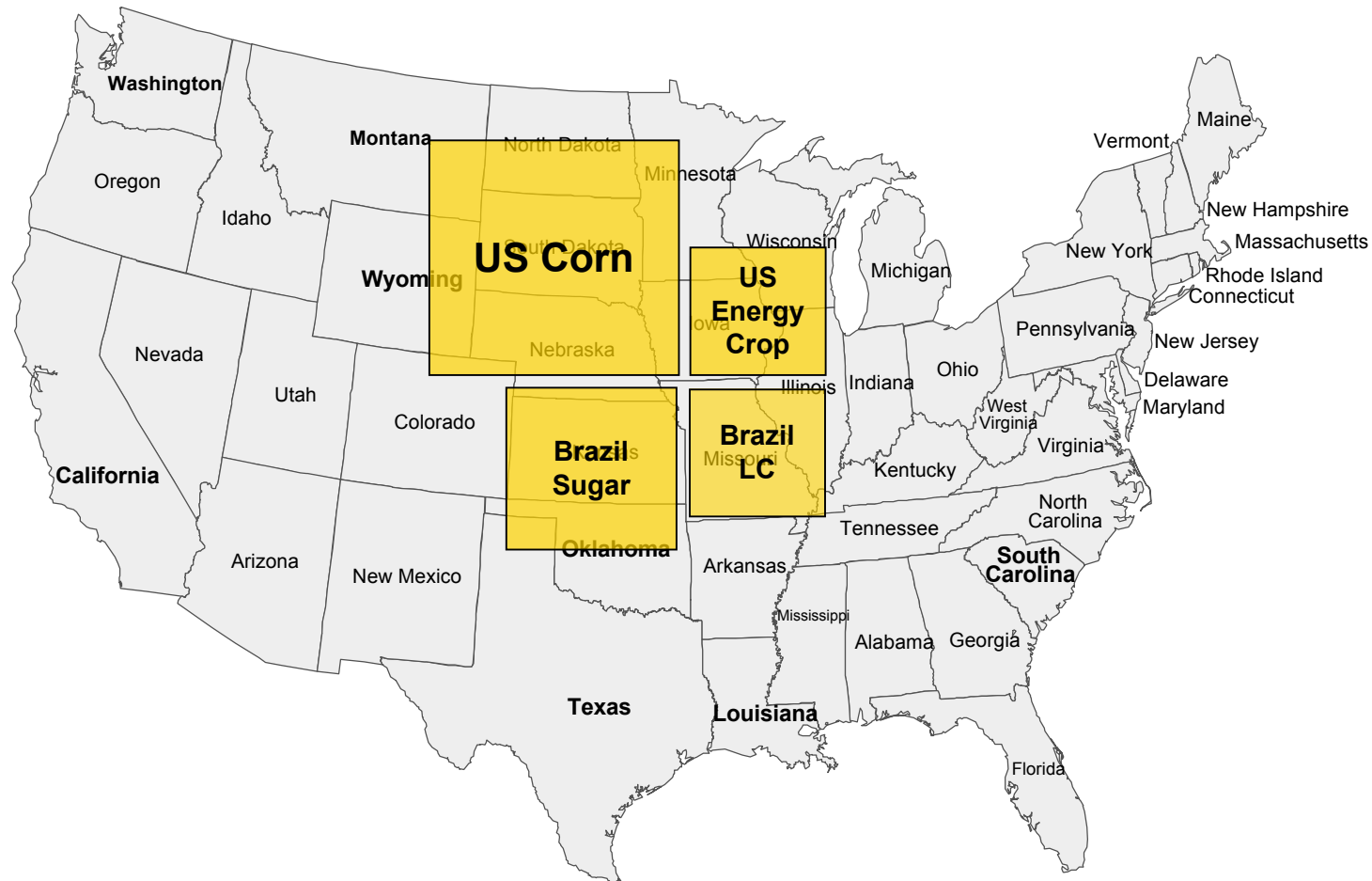
- **Feedstock** – Limits include use of 50% set aside land and crop optimisation; Potential for 1.2 bn gall ethanol if cereal exports used; then LC required; increasing imports of veg oils for biodiesel
- **Capacity** – insufficient indigenous feedstock for announced capacity
- **Ethanol demand** beyond 10% - will require FFVs and E85 distribution

US constraints

- **Corn supply** – max 15-17 gallons then LC technology needed
- **Distribution** – river barge limited reach, ageing infrastructure
- **E85/FFVs** – to exceed 15 bn galls (10% vol) will require E85 distribution priced at energy parity and FFVs

Brazil constraints

- **Trade Policy** – Tariffs in demand markets will limit investment in exports
- **Domestic markets** – rapid growth in FFV's limit export volumes



30% v/v replacement adjusted for lower energy content of ethanol



3

Quality: conventional bio-components are essential to build the industry. We should not stop with the molecules we have.



Ethanol – gasoline component

FAME - diesel component

Fuel performance characteristics

- High octane (favors good performance) but...
- High blend vapor pressure
- Energy content approximately 1/3 lower than conventional gasoline
- Water affinity and risk of phase separation when blended with gasoline

- Sulfur and aromatic free
- Higher cetane value and improved lubricity properties vs. diesel
- Low temperature and stability/deposit formation issues
- Energy content 15% lower than conventional diesel

Consumer attractiveness

- Energy content and water affinity mean that ethanol is not a good premium gasoline component

- Stability and energy content mean that FAME is not an ideal component for premium diesel

Blending limitations

- Corrosive effect as well as performance issues such as fuel economy limit the content of ethanol in standard grade gasoline (US 10%v/v, EU 5%v/v)

- Typically limited in standard grade diesel (e.g., 5%v/v max. Europe)
- OEM concern over deposit formation in high pressure fuel injection systems used in modern diesel passenger vehicles

Supply chain implications

- **Poor** – can only be blended at the terminals, ethanol-containing blends cannot be moved by pipeline or ship and implies a segregated distribution network
- **E85** – issues around dispenser certification (safety)

- **Moderate** – low concentration blends (up to 5%) treated as fungible in many markets; higher blend levels may have impacts on pipeline contamination

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4

Sustainability: fundamental to an enduring industry is the avoidance of harmful environmental and social impacts



Issues (not exhaustive) include:

- Land rights, including economic and physical displacement
- Placing stress on the world's limited water resources
- Biodiversity
- Deforestation – the destruction of High Conservation Value Forest (HCVF)*
- Child and forced labor and other employment abuses
- Planting on peat soils
- Community conflict issues
- Effects of monoculture on local food production and local economies
- Pollution and environmental damage (water / soil / air), including related socio-economic impacts
- Net greenhouse gas balances resulting from land use change

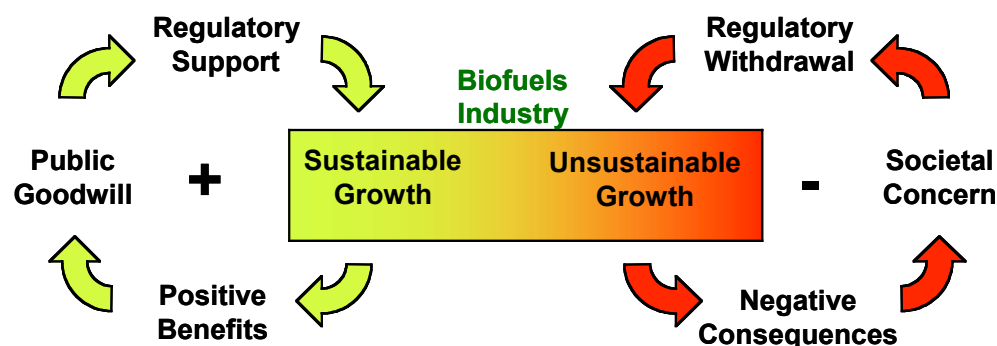
* HCVF is technically defined according to principles defined by the WWF



4 ...meaning industry growth is reliant on:



How regulators can help grow a sustainable biofuels industry



- Market-based regulations that balance environmental, energy security and rural development goals that face communities around the world
- Encouragement of innovation at all stages of the value chain. It is important that regulation does not pick winners but instead allows the market to find solutions
- Policy that is geared to emissions reductions or the quantity of fuel energy replaced – rather than mandated volumes of a particular product.
- Regulatory mechanisms which apply equally to all and which maintain flexibility – for example avoiding fixed per gallon mandates.
- Supporting guidelines for sourcing from sustainable and responsible production routes

4 ...meaning industry growth is reliant on:



How technology has a major role to play



Challenges

- ① Cost
- ② Availability
- ③ Quality
- ④ Sustainability

Technology Solutions

- Ⓐ Lignocellulosics
- Ⓑ Energy Crops
- Ⓒ Plant Modification
- Ⓓ Advanced Conversion

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- ▶ Shaper of an emerging industry
- ▶ Leadership position in the industry

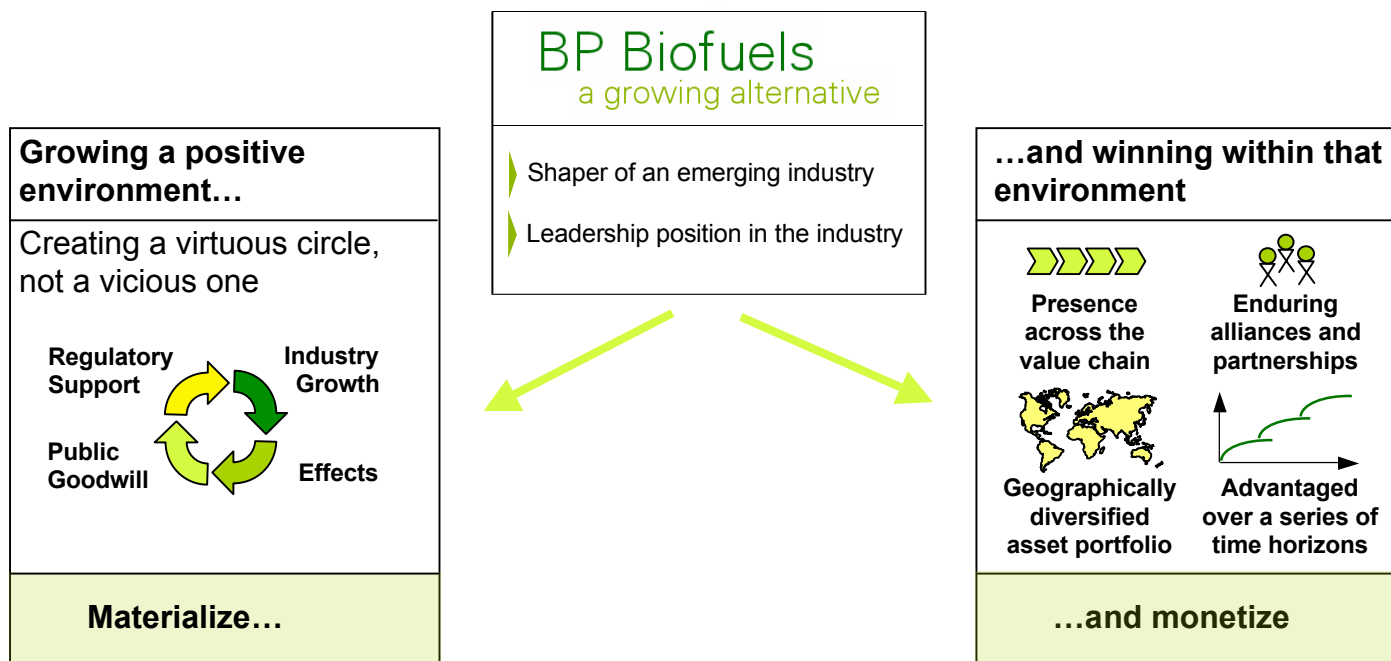
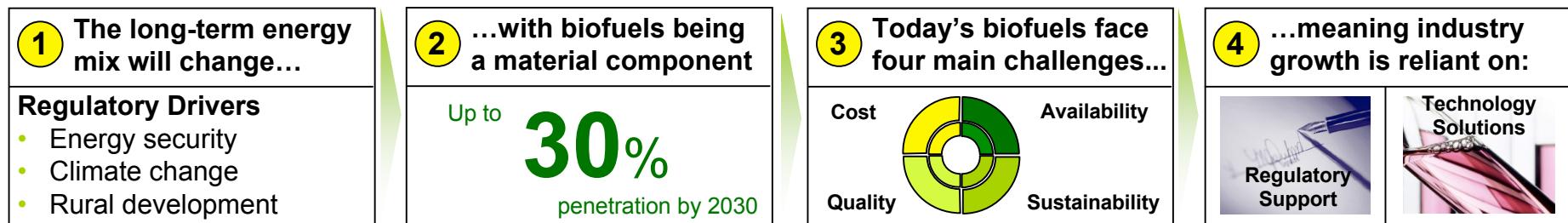
BP is committed to the sustainable growth of the biofuels industry



- Dedicated Global Biofuels Business Unit
- Distinctive Positions
 - **Advanced Technologies & Molecules**
Energy Biosciences Institute
Partnership with DuPont to develop biobutanol
 - **Feedstock Availability**
Non-food crops grown on marginal land (e.g. Jatropha)
 - **Sustainability**
The promotion of industry standards for biofuels sourcing and production (similar to Equator Principles)



Summary

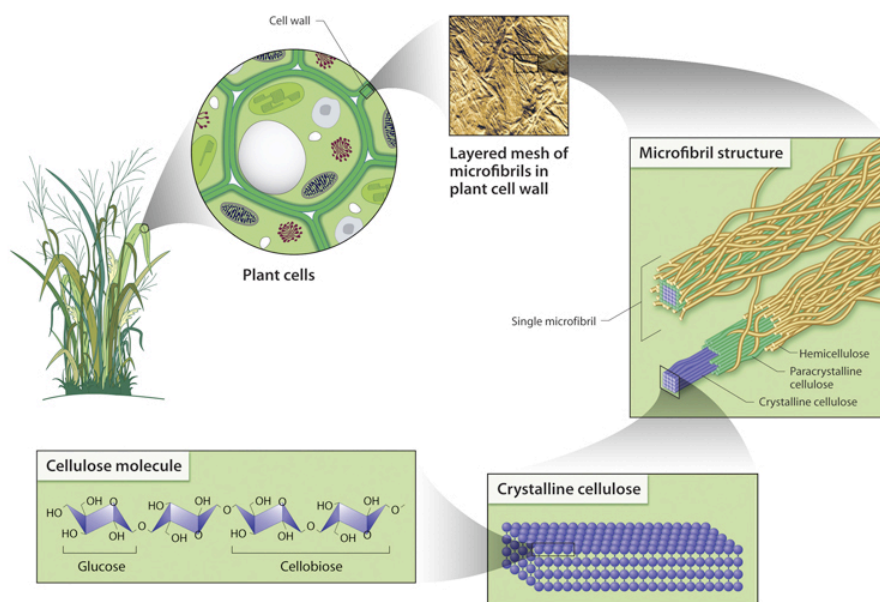




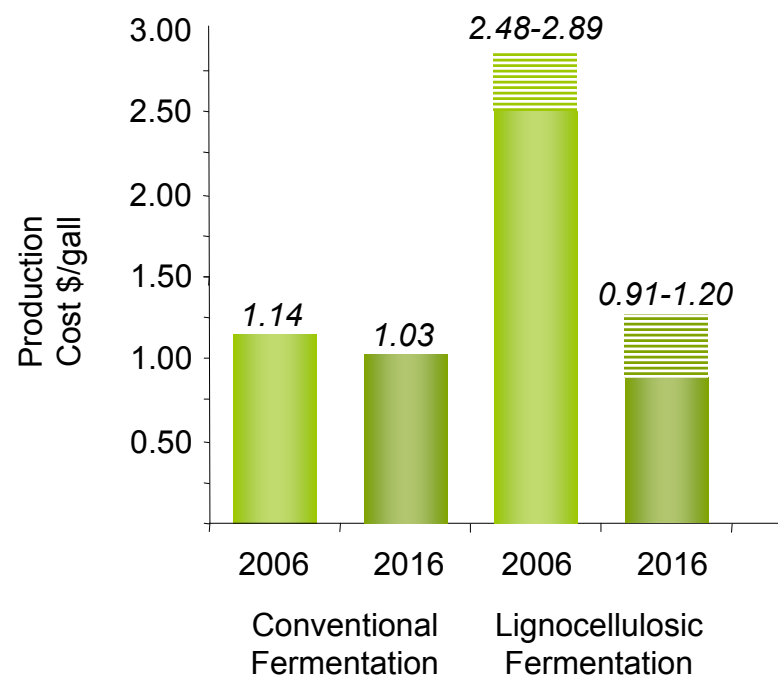
Backup Slides



① Agnocoellulosics: 25-100% yield improvements* in 5-10 years.
Brazilian sugarcane will remain competitive (economics & GHG)



ILLUSTRATIVE EXAMPLE – US CORN



* Corn example: 25% (fibre only); 100% (stover), with 50% of stover must remain in field to preserve ecosystem

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①

Energy crops: non-food crops grown on marginal land reduce competition with food, especially in developing countries



BP Jatropha Nursery Plantation, Andra Pradesh State, India

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©

Plant modification: improving economics and addressing sustainability by reducing the input intensity



- Current generation technology can be input intensive e.g.
 - Water usage for plant growth
 - Acid usage in first generation lignocellulosic conversion
- Opportunities:
 - Genetically modified plants which are less thirsty
 - Plant decomposition triggered by UV-light



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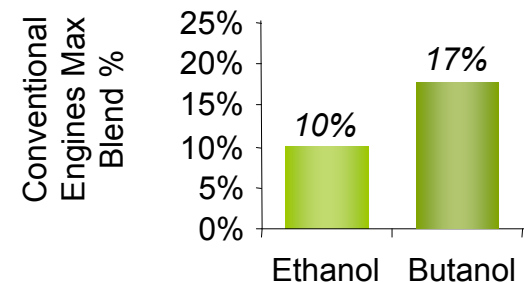
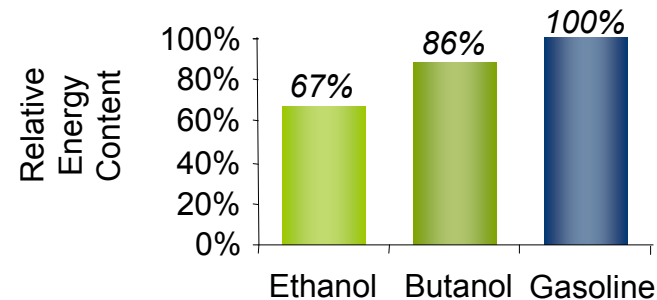


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Advanced conversion: developing better quality molecules which can also increase penetration



- Next generation biofuels offer advantages over conventional biofuels (e.g. ethanol)
- Benefits:
 - Not corrosive – can use in higher concentrations
 - Low water affinity – no risk of phase separation; can pipeline
 - Easier to blend – no RVP issues
 - Higher energy content – better for the environment; better for the consumer (fewer fills)



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